

Investigation of Interfacial Chemistry of Microorganisms

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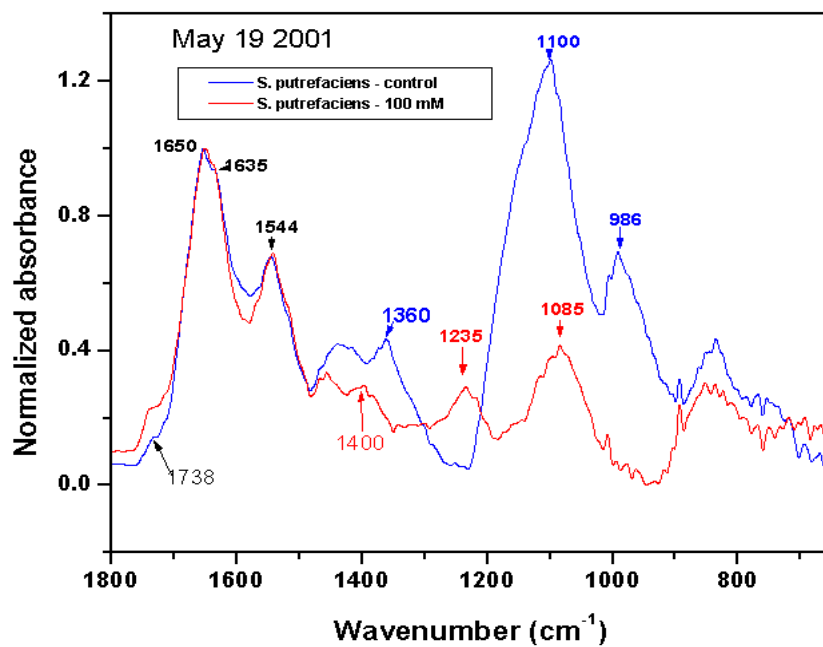
INTRODUCTION

Remediation of Department of Energy (DOE) sites contaminated with toxic metals and radionuclides is a complex and costly problem. Several bioremediation strategies currently being explored exploit the metabolism of naturally-occurring dissimilatory metal-reducing bacteria (DMRB). These bacteria catalyze the mobilization of some metal oxide-associated trace elements and the precipitation of many otherwise soluble metals and radionuclides. Our recent work centers on the effects of co-contaminating trace metals on the microbe-mineral interface.

RESULTS

Secondary ion mass spectrometry (SIMS) and synchrotron radiation Fourier transform infrared spectroscopy (SR-FTIR) were applied to examine biochemical changes incurred at the surface of *Shewanella putrefaciens* cells due to exposure to soluble arsenic. Cells responded to the insult with altered membrane fatty acids (observed by SIMS) and exopolysaccharide production (observed by SR-FTIR).

SR-FTIR at ALS beamline 1.4.3 was used to analyze *S. putrefaciens* cells with and without exposure to 100 mM As(V). The main difference between the spectra of stationary phase cells was the clear lack of a broad peak associated with carbohydrates in the As-exposed cells that was present in the unexposed cells (Figure below). In its place were two distinct peaks indicative of phosphodiester bonds. Phosphodiester bonds are abundant in cell membranes, forming the junction between glycerol and fatty acids. Cell surface carbohydrates likely indicate either a capsule (exopolysaccharides), or common membrane lipids called lipopolysaccharides (LPS). The role of the capsule is especially important in nature, where it can aid the cell in its defense against viruses, hydrophobic toxins such as detergents, and dessication. In addition, it has been implicated in the attachment of some microorganisms to solid substrates. An impaired ability to form exopolysaccharides would likely limit the cells competitive fitness in nature. The LPS may be largely responsible for the net negative charge on the cell surface, implicated in attachment, metal binding, and nutrient transport across the outer membrane. Additionally, the LPS may stabilize the membrane's physical shape and structure. An impaired LPS would also put the cells at a disadvantage in the environment.



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